True Value (1)

- It is impossible to know the value of a measured quantity due to the numerous sources of error encountered.

- The true value is usually defined as the most probable best measured or reference value.

True Value (2)

- Let the unknown true value of some unvarying quantity be X.
- The measurement of this quantity has yielded (n) independent observations x1, x2, x3,……, xn.
- Suppose that each observation is accompanied by a random errors e1, e2, e3,……., en which are different in magnitude and sign.

$$e_i = x_i - X$$

$$e_1 = x_1 - X$$

$$e_2 = x_2 - X$$

$$e_n = x_n - X$$

$$\sum_{i=1}^{n} e_i = \sum_{i=1}^{n} \left(x_i - X\right) = \sum_{i=1}^{n} \left(x_i\right) - n \cdot X$$

True Value (3)

Suppose that in the above set of observations the sum of the value of positive random errors equals the sum of value of negative random errors

$$\sum_{i=1}^{n} e_i = 0$$

We get

$$X = \frac{1}{n} \cdot \sum_{i=1}^{n} x_i$$

From the above equality we conclude that the arithmetic mean value X is the closest approximation to the true value that can derived from available experimental data.

Accuracy

It is the closeness with which the indication of an instrument approach the true values of the measured quantities, i.e. the difference between the true value of the measurand and the measured value indicated by the instrument.

Error

The differences that exist in any measurement are responsible for the error of measurement; i.e. the difference between the true and the observed (measured) value.

Absolute error:

The error is expressed in the same units as the measured quantity

Absolute Error = ±(measured value – true value)

Relative error:

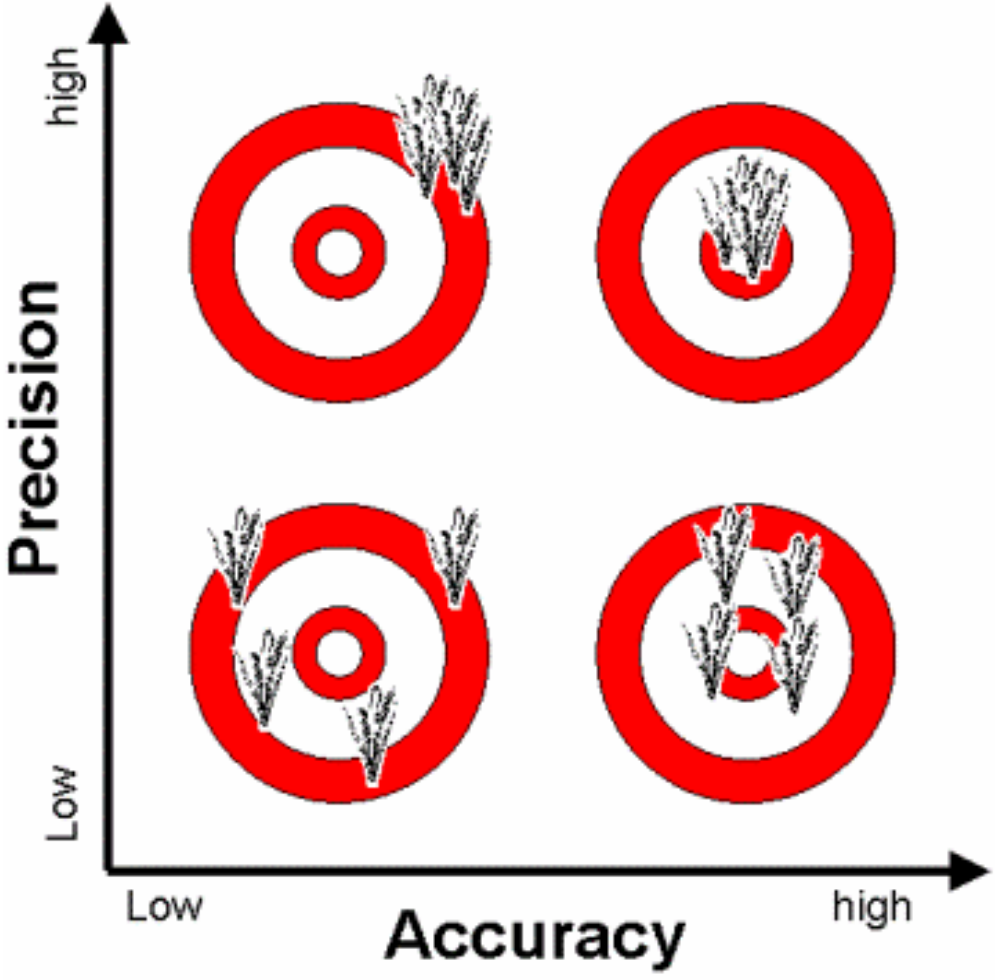
In this case the error is expressed in a relative terms as a fraction or a percentage of the measured value

Percentage Error = absolute error/measured value × 100

Precision or Repeatability

This is the repeatability of readings taken of the same value by the same instrument.

Difference Between Accuracy and Precision

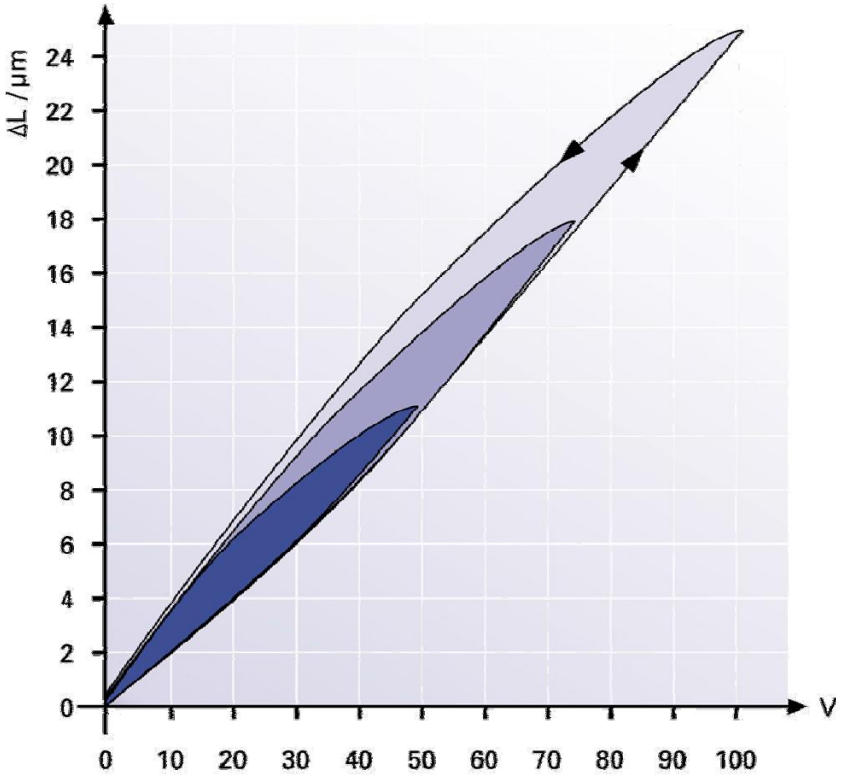


Hysteresis in Measuring Systems

A system free from hysteresis will produce the same reading irrespective of whether threading has been achieved by increasing from a lesser value or decreasing from a higher value.

Hysteresis arises because of:

strain energy stored in the system, stack motion in bearing and gears, and bearing friction, etc.



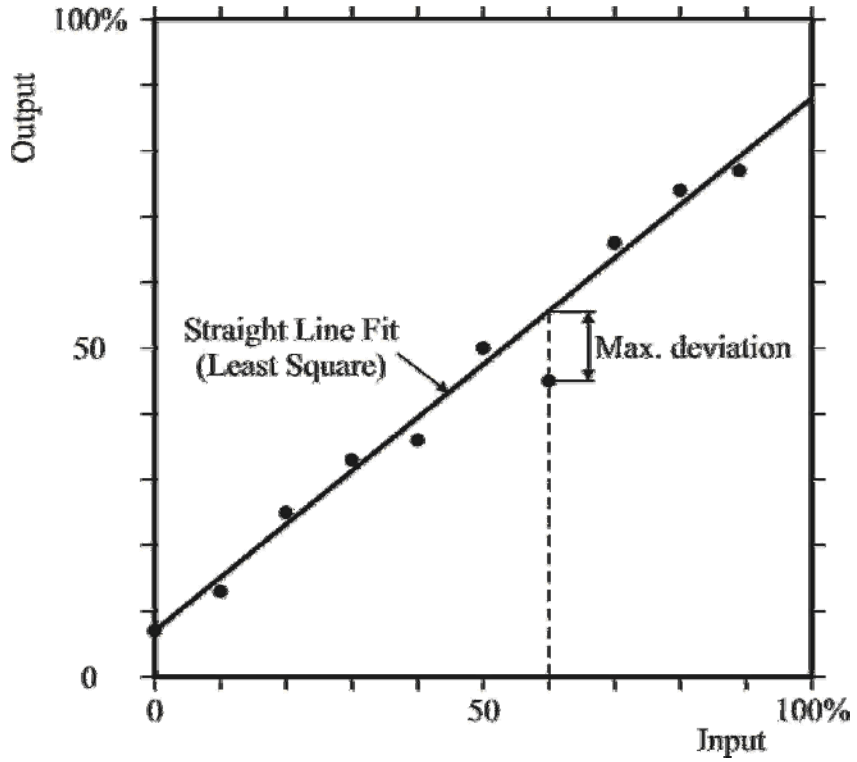
Linearity (1)

- Linearity is the closeness of calibration curve to specific straight line.
- Linearity is expressed as a percentage of the departure from the linear value i.e. the maximum deviation of the output curve from the best fit straight line during any calibration cycle.

Linearity (2)

Absolute Linearity = maximum deviation

Percentage linearity = (maximum deviation)/(scale value) ×100




Thank You!